

iv Warm Space Components

In this section, the space allocations of ring devices and components in the warm sections are defined. The data given here is being used in the development of the RHIC Space Allotment Drawings. These drawings together with the Optics Database represent the source for the Survey Database and, consequently, define the installed location of the warm space components.

The magnet positions in both RHIC rings are fixed and defined by the RHIC Optics Database. The RHIC Optics Database includes, in addition to magnets, all components that affect the beam or perform beam diagnostics, in particular rf cavities, BPMs, wall current monitors, gate valves, etc. These elements are defined in “slots” which are delimited between two connecting flanges at the ends of the element. Correspondingly, a warm space is defined as drift space between the magnet elements, with the warm space being measured as the distance between the vacuum flanges at the ends of the cold cryostats. AUTOCAD coordinates of the magnet centers and component positions are provided directly from the Optics Database in “dxf” format, readable by AUTOCAD. In the RHIC Space Allotment Drawings for the warm spaces, the component locations are defined by the distance from the nearby Interaction Point (IP), as measured on the “equivalent” orbit. The drawings are updated through the C-AD Engineering Change Notification (ECN) system. Images of these drawings, in “.tif” format, are available through the C-A Engineering Archives (drawing prefix 0105-) under the “Useful Information” section of the Accelerator Divisions webpage. In order to keep track of the location of these components with respect to the Optics Database, any new component to be installed in the Warm Space must be approved using the Engineering Change Notice (ECN) system. Following the C-A Operations Procedures Manual 9.3.3, “Procedure for Obtaining Approval to Place Devices into the RHIC Warm Beam Tube Regions”, device placements are reviewed, approved and incorporated into the RHIC Space Allotment Drawings.

Layouts of the components in the six interaction regions (IR) are illustrated in the “.tif” images noted above. All warm spaces, other than those across the IPs, are jumpered by cryogenic by-passes, within the tunnel, which start and end with cold-to-warm transitions. The warm space length is defined between the vacuum flanges of the transitions. The warm spaces are terminated by bakeable beam vacuum gate valves. These valves are directly attached to the flanges at all cryostat ends of Q4s, Spin Rotators, Q3s, Triplets and DXs (IP side only). Warm bakeable devices and vacuum pipes are connected between the valves, usually by bellows. The space allocation for warm

devices and the interconnecting beam tubes and bellows is detailed in the RHIC Space Allotment Drawings. The warm spaces are classified as *long* and *short* warm drift spaces as follows:

Long Warm Drift Spaces at each of the six interaction regions (IRs).

1. From the IP to DX magnets on each side. This warm space is to $l = 7.120$ m in every IR, and is defined as the distance from the crossing point to the flange on the bellows of the ion pump stand connected to the warm beam position monitor at the DX cryostat. (The distance from the IP to the DX flange is 8.614 m).
2. From the end of the cryostat at the Q3 magnet to the beginning of either a Q4 magnet or a Spin Rotator. The length of the warm space from the triplet cryostat flange (38.439 m from the IP) to the flange of the Q4 quadrupole is $l = 34.122$ m. On both sides of the 6 and 8 o'clock interaction points, cold spin rotators are connected to the quadrupole Q4, reducing the warm space to $l = 21.660$ m in the 6 and 8 o'clock IRs.

Short Warm Drift Spaces between the D0 and DX magnet in every IR.

The DX-D0 warm space of $l = 4.895$ is identical at every IR, and represents the distance between the flanges at the end of the DX cryostat and at the vacuum valve connected to the D0 cryostat. Located on either side of the 6 o'clock IP, in the *yellow* ring of sector 5 and the *blue* ring of sector 6, there are two *additional* short warm spaces in each ring. These warm spaces contain the injection magnetic septum (Lambertson) magnets at Q7-Q8 and the fast injection kicker magnets at Q9 - D9.